# A REMARK ON THE LEGIBILITY OF PRINTED TYPES

By F. M. URBAN

Miss B. E. Roethlein published in the January number of this JOURNAL an account of a very interesting investigation on the relative legibility of different faces of printing types. At the end of the paper she discusses the influence of the quality and texture of paper, and mentions the suggestion of Babbage that slightly yellowish paper be used in the manufacturing of books. She remarks that, from the data available in the literature, it is impossible to decide whether this suggestion is of real value or not.

It does not seem that this idea was intended for ordinary books which are read in the customary way, but for reference books only which, like tables of logarithms, must be consulted a great many times and where the information required must be picked out from a great number of similar data. It seems that Babbage's idea has stood the test of experience and is now past the experimental stage. The geographical survey of the French army (*Service géographique de l'armée*) publishes logarithm tables which make use of Babbage's suggestion. All these tables are printed on colored paper which is absolutely dull, so as to avoid the glare of reflected light. The tables which are most frequently used are printed on slightly yellowish paper; and only the tables of the trigonometric functions in the hexagesimal division of the circle are printed on blue paper, in order to make these tables easily recognizable. The success of this plan is indisputable. The first edition of the tables with five places was soon exhausted; a new edition had to be issued in 1906, which except for the elimination of a few misprints is an exact reproduction of the first.

These tables are superior in many respects to the ordinary tables, so that one cannot attribute their success to any particular feature. The fact, however, that the colored paper is used in both editions suggests that this innovation has proved to be useful. Anybody who is sufficiently interested can easily verify the superiority of the tables of the French survey by the following experiment. Use these tables the first evening for from two to three hours, and on the following evening repeat the calculations with any other logarithm table. The mental strain and the fatigue of the eyes will be considerably greater in the second case. I called the attention of several of my friends to these tables and they all agreed as to their superiority—a testimonial which found its realistic expression in the purchase of a copy of the book by those who have to use logarithms a good deal.

I should like to call the attention of the experimentalists to the fact that numerical tables offer several interesting psychological problems. I will mention in this place only some of the more obvious ones. The ordinary table of logarithms contains ten numbers on each line; and from this group of ten numbers one has to choose the right one.

This process is not a simple one, because the eye has difficulty in following the line accurately. Most people aid the eye by indicating this movement with the finger and stopping at the right place. The above mentioned tables of the French survey eliminate this difficulty by printing the logarithms directly alongside the corresponding numbers. This makes the tables somewhat longer; but it facilitates the work of the computer in a very high degree.

It seems that this difficulty of keeping the eye on the same line depends on two factors, the amount of space between the lines and the number of lines which are grouped together. The ordinary tables group the lines in sets of ten,—the groups being separated either by a wider space or by a bar. Groups of ten are entirely too large and it seems advisable to split them up into groups of three lines separated by wider spaces, and to put the tenth line between two solid black bars. This is, for instance, the arrangement of Bruns's table of the probability integral. While working with these tables one need not use one's finger to indicate the correct entry; and mistakes are very rare. The increase in the size of the tables is inconsiderable, amounting to only a few lines per page.

It ought to be possible to get some experimental material showing the best arrangement for tables of this kind. This could very well be done with an apparatus similar to the one employed by Miss Roethlein, adapted in such a way as to investigate the influence of the spacing of the same type. Mistakes are rare if the lines are very far apart; but they seem to become more frequent with decrease of the space between the lines. It is, therefore, a legitimate question to ask, what is the minimal space between the lines which is compatible with accurate reading. Such results might save unnecessary expense in printing; and—what is perhaps more important—they would save time and energy in computing. Numerical calculations are carried on all over the world on an ever-increasing scale; and any slight saving of time has a very definite value in dollars and cents.

Another important point to consider is the amount of fatigue produced by different types and by different spacings. The energy and the eyesight of the calculator are assets which must not be trifled with. The compilers of many of the logarithm tables which are on the market apparently did not take this fact into consideration at all. The figures are printed on glossy paper as close together as possible, thereby producing on the eye a most disagreeable effect.

These questions have to do with a problem in optics, which can be approached by straightforward methods. My next observation refers to the psychology of memory. In selecting logarithms from a table, or in consulting any other numerical table, one has to remember the figures while putting them down on paper. My observation is that I can take in five or six figures almost at a glance, and remember them accurately for the short time necessary to write them down. It requires a decided effort for me to read a seven-place logarithm at a single glance; and in copying any number which contains more than seven figures I usually divide it into groups of convenient size. This certainly is not entirely due to lack of practice on my part, because several professional computers, whom I had a chance to interview on this topic, seemed to agree that six or seven figures is just about the limit which can be taken in at once. Only one of my friends seems to be able to select a ten-place logarithm from a table at a single glance; but he is gifted with an unusually good memory, as is also shown by his achievements as a blindfolded chessplayer. It seems that this fact is intimately connected

with the problem of the *Umfang des Bewusstseins,* and might be investigated by the same methods which have been employed in that topic.

My next and last observation refers to a much more complicated psychological problem and is directly suggested by the above-mentioned French tables. It is customary to divide the circle into quadrants of ninety degrees each,—a custom which we inherit from the Babylonians, if one may believe our historians. This hexagesimal system has many inconveniences due to the fact that it does not use our decimal system of numbers. In order to avoid them, Delambre divided the right angle in 100 degrees and calculated tables of the trigonometric functions for this new division of the circle. This division is also adopted in the new tables of the *Service géographique de l'armée;* and any one may readily see from these tables that the centesimal division of the circle is by far superior to the old system. All the calculations are much simpler and afford fewer chances for mistakes.

The centesimal division of the circle is—or at least ought to be—universally known by the profession; and it is a surprising fact that the innovation has not yet received unanimous sanction. It certainly is just as simple to teach that the right angle contains one hundred degrees as that it contains ninety degrees. There are no material interests at stake, because the instruments for measuring angles may still be used so long as they are accurate, since it is an easy matter to transform the old readings into the new system. One involuntarily thinks of the obstacles which the introduction of the metric system has encountered, although the case is slightly different here. People naturally cling to customs and institutions which they regard as characteristic of their country; and a change in the system of weights and measures necessitates a certain initial outlay which is perhaps not quite inconsiderable. No such reasons can be urged against the introduction of the new division of the circle; but it seems that every new idea has to overcome a certain resistance before its true value is recognised. The arguments brought forward in defense of the old system are very likely of small intrinsic value; but they are certainly of interest to the psychologist, and their study would make an interesting chapter of *Völkerspychologie.*